EARLY OPENING OF KEW GARDENS

OUR readers are no doubt aware that a movement has been set on foot for the earlier opening of Kew Gardens, a step which, if taken, would, we believe, wholly alter the character of that institution. It would, we feel assured, seriously interfere with all scientific work, and with the uses which we hope will one day be made of the gardens in the mornings by science schools. Moreover, we doubt if there exists any general desire for their early opening, and are inclined to believe that the movement is quite local in its origin and extent. On this subject we are glad to quote the remarks in a recent number of the *Economist*, both on account of their pertinency and force, and because we rejoice to see the true interests of science advocated by papers not professedly scientific :—

"The question has been mooted of late whether the Royal Botanic Gardens at Kew could not be opened to the public at an earlier hour than the present time of 1 p.m. A little reflection will enable those who ask this question to perceive that it can scarcely be answered in the affirmative without inflicting a serious injury on the real utility of the gardens and on the public service. In the first place, all the real work of the gardens has to be done during the hours when they are closed to the public. As it is, this time is barely long enough for the duties which have to be performed in it. To open the gardens in the morning would require a second staff of gardeners and workmen, as strong, or nearly so, as the existing one. Even with this extra assistance and this greatly increased cost, the work could not be as well executed as it is at present. In the next place, as the name of the gardens implies, they are *botanic* gardens. Besides those who ordinarily frequent the gardens for pleasure, there are many artists and scientific men who visit them for purposes of study; the only time when they can do this with advantage is before the general public are admitted.

"Of late the public has come in rushes of 12,000 to 60,000 in a day. If only 10,000 persons were in the gardens in the forenoon, all work would necessarily be at an end, and it would be impossible to maintain the existing character of the place. As it is, the Botanic Gardens at Kew are more accessible to visitors than any other public institution. Week days and Sundays alike the gates stand open. At the British Museum and the National Gallery—between the hours of opening which and the gardens at Kew comparisons have been drawn—there are many hours and even days when those institutions are necessarily closed to the public for purposes of cleaning, putting in order, and making good the results of the wear and tear of the enormous traffic. But if the heads of those institutions had, like the Director of the Royal Gardens at Kew, to *grow* what they exhibit, they would doubtless require many more close days than they do at present.

"Nor is it merely the work of maintaining the gardens and grounds in their present efficiency which has to be carried on in those hours during which the gates are closed to the public. It should not be forgotten that the Royal Gardens at Kew have performed services to the British Empire which no other public institution could undertake. The successful introduction of the Cinchona tree into India (a resource to that country the importance of which cannot be over-estimated), the efforts being made at the present time to procure fresh and improved coffee for Ceylon—to single out only two from a host of similar instances in which the Director of Kew Gardens has freely placed his botanical science and invaluable practical knowledge at the service of the public—will show how diversified and extensive the operations of the gardens are. To prevent these being carried out as they are at present, would be a serious injury to the public service. The present Director, Dr. Hooker, and his father, Sir W. T. Hooker, who held the same office before him, have done everything in their power, consistently with the proper maintenance of the gardens in due working order, to facilitate the use of them by the public generally; and in the interest of science as well as for the prosperity of the gardens, it is to be hoped that the public will see the desirableness of being satisfied with the present very ample allowance of opportunity for visiting the Botanic Gardens at Kew, and that they will not insist on acting over again the fable of the goose and the golden eggs for the sake of a little present pleasure."

THE GEOGRAPHICAL DISTRIBUTION OF AURORÆ

IN an interesting paper in Petermann's *Mittheilungen* for October, Prof. Fritz gives the results of his extensive researches on this subject. The investigation is beset with difficulties, not only from the deficiency of observations, but from their irregularity. While some observers content themselves with noting only the more remarkable displays, others register the faintest light to the north as an aurora. One observer continues his observations for tens of years, while another, whose zeal has been roused during a period of maximum frequency, allows it to cool when a minimum, with its rare and feeble displays, again returns. The research is further complicated by the fact that the appearance is not only dependent on latitude, but undergoes a periodic change, which in the region of most frequent display manifests itself less in diminished number than in diminished intensity of aurora; and because in some places the phenomenon is far more frequently concealed by a cloudy sky than in others.

As far as possible to eliminate these sources of error, Prof. Fritz compares the mean number of observations for any given place with the mean for mid-Europe between 46° and 55° lat. (or between the English and Scotch boundary and the Alps) for the same period, by the following formula :—

$$M = \frac{C}{172} \cdot \frac{B}{E} = 28\,\frac{B}{E}$$

where M is the mean calculated frequency for the given place, C the total number of aurora in the author's catalogue for mid-Europe from 1700 to 1871=4830, B the number of auroræ for the period of observation for the given place, and E the number from the author's catalogue for mid-Europe for the same period. Thus, for example, he calculates for Christiania :—

1837-1854	B = 529	E = 581	M = 25·5
1855-1870	B = 436	E = 568	M = 21·9
1837-1870	B = 965	E = 1,149	M = 23·3

As we have already remarked, a complete agreement of the different mean values is not to be expected, both on account of errors of observation, and from the various local influences of climate and situation. Professor Fritz gives tables of the numbers of observed auroræ, and calculated values of M for upwards of 200 places in Europe, Asia, and America; and from these, proceeds to lay down on a chart of the northern hemisphere a series of curves of equal frequency of auroral display, which he calls *isochasmen*. He discusses with great care the probable value of the observations, and lays down the curves so as to include on either side of them as many observations above as below the required value. But a few instances will make his method clearer than any description.

The zone M = 0·1 passes through the southermost part of Spain, through Calabria, and just north of the south coast of the Black Sea, through the Sea of Aral and Lake Balkchash, south of Saghalien and the Kurile

Islands, north of the Sandwich Islands, through the southern point of California, through Mexico and Cuba, and just north of Madeira. In fact, through its whole course it lies just south of the isoclinic line of 60° inclination and between this and that of 50°; a fact forcibly illustrating Prof. Fritz's remark that the isochasmic curves lie nearly parallel to those of equal magnetic inclination. For this curve we have for the value of M in Madeira, Cadiz, Naples, Smyrna, Teneriffe, and Cuba 0·1, for the Azores 0·15, for Barnaul 0·7, and Nertschinsk 0·6.

It is well known that both in ancient and modern times polar lights have been seen occasionally south of this line, as for instance in the year 502 at Edessa, in 1097, 1098, and 1117 in Syria, in 1621 at Aleppo, and in 1872 over most of North Africa and India.

North of this line their frequency rapidly increases, and we have M = 1 beginning at Bordeaux, through Switzerland and north of Cracow, south of Moscow and Tobolsk, and north of Lake Baikal, through Udsk and the southern point of Kamtschatka, through northern California and the north of Florida. For the values of M for this zone we have for Perpignan, Marseilles, Bordeaux, La Rochelle, and Viviers, a mean of 1·1, for Moscow 1, for Tobolsk 0·9, Barnaul 0·7, and Sacramento 0·8. Singularly enough, probably from climatic or other local causes, the value of M for New Orleans is only 0·14.

The zone for M = 30 passes through the north coast of Ireland, through Scotland near Edinburgh, through the White Sea and the Gulf of Obi, where it attains a latitude of 70°, and then tends a little southward through Werchni, Kolymsk, and the Bay of Anadyr, near Sitcha, Cumberland House, Quebec, and the north coast of Nova Scotia, to the north coast of Ireland.

North of this the frequency of aurora rapidly increases. The zone of M = 100 passes through the Hebrides, Shetland, near Drontheim and Wardon, through Nova Zembla, across Behring's Straits, just south of the Arctic Circle, south of Lake Athabasca, through Hudson's Bay, and just north of Newfoundland.

Only a little further north we reach a zone of maximum frequency, beyond which the intensity of auroral display again declines, contrary to the old idea that its intensity increased up to the poles. This zone passes just north of Faroe and of the North Cape, through the northern part of Spitzbergen, and just north of the Siberian coast, near Point Barrow, Great Bear Lake, and Nain on the coast of Labrador. Iceland, Spitzbergen, and Greenland lie considerably to the north of this zone, and auroræ are not there so frequent, nor especially so brilliant as at Faroe, the north coast of Norway, and Labrador. Of this Prof. Fritz adduces much evidence, and in addition draws attention to the important fact, that while south of this zone of maximum frequency the arches are generally north of the observer, from the north of it they appear to the south, and upon it, indifferently, north, south, or overhead.

It will be noticed that the system of curves tends strongly southward in North America, while in the Atlantic and Pacific Oceans the curves pass rapidly northward and reach their highest latitudes in Central Asia. This is borne out by the fact that the great auroræ of Aug. 28 and Sept. 1, 1859, were not noted in the meteorological registers either of Nertschinsk, Barnaul, or Jekaterinburg, nor were they seen at Tigris in Yozgat (39° N.), Mosul (36° N.), or Kharput (33° N.); whilst in the Atlantic Ocean they were visible at least to 12° N., in Africa to St. George del Mina (28° N.), and in America during the maximum they were frequently observed in the Antilles (20° N.)

The geographical extent of great displays of polar lights is very significant. That of Sept. 1, 1859, was visible in the Sandwich Islands (20° N.), Sacramento (20° N.), San Salvador (13° N.), in the whole Atlantic Ocean to 12° N., in Western Africa to 14° N., and in the whole of Europe. At the same time the southern lights were seen in Australia, South America to 33° S., and in the Indian Ocean to 39° S.

For the southern hemisphere there are as yet too few observations to calculate the distribution as has been done for the north. For Hobarton (43° S.) M = 6, and for Melbourne 15. In low latitudes they have been seen at Cusco (12° S.) in 1744, at Rio Janeiro (23° S.), 1783, at Bloemfontein (29° S.), and Vaal-Fluss (28° S.); in Africa and at Réunion and Mauritius in 1870 and 1872.

Dr. Fritz remarks that his zone of greatest frequency nearly coincides with that given by Muncke (in "Gehler's Wörterbuch), and that the whole curve-system has great similarity to the zone-system of Loomis in *Silliman's Journal*, vol. xxx. The curves cut the magnetic meridians in most places at right angles, and are very similar to the isoclinic curves constructed by Hansteen in 1780, while they noticeably deviate in places from those of Sabine of 1840, and approximate, at least in the best determined portions in East America, the Atlantic Ocean, and Europe, with the isobaric curves of Schouw. It may here be remarked that the curves of increasing frequency in the Atlantic Ocean tend towards the point of lowest barometric presure.

It is also noticeable that throughout the greater part of the northern hemisphere the curves tend to follow the form of the continents, and the limits of perpetual ice which depend upon it; and Prof. Fritz points out that in mean latitudes the magnetic meridians and the direction of visibility of the aurora are coincident, and are mostly (viz., from the Atlantic Ocean to the Asiatic Icy Sea) normal to the limit of ice. The greatest deviations from this rule exist in places where the ice-limit is most irregular, as, for instance, in Hudson's Bay and the Gulf of Labrador. It may here be noted that at Fort Franklin, Fort Normann, and Wardochus the northern lights begin in spring to be seen most frequently in the south at the same time as the ice-limit deviates furthest in the same direction. At Bossekop, according to the report of the Scientific Commission, the northern appearances are to the southern ones as 3·6 to 1 during the four last months of the year, but only as 2 to 1 in spring. Wrangel, from his observations on the coast of the Arctic Ocean, concludes that the freezing of the sea is favourable to aurora; but remarks that in the east of Asia the appearance is more frequent as the coast is approached, and is most so during the increasing cold of November, while it becomes rarer in January, when the coast ice extends further to the northward. M'Clintock notices that aurora was most frequently visible when water was in sight; and Hayes, that it was more frequently seen in the direction of some piece of open water than of the magnetic north. These observations would rather support a belief common in Scotland that the frequency of the aurora varies with increase and decrease of the Greenland ice, and render it probable, at least, that ice-formation is one of the most prominent local influences by which auroral distribution is affected. It seems not unlikely that the neighbourhood of the Alps may influence the frequent displays in North Italy. These and other points, however, require more systematic observation, and it is especially desirable that some notice should be taken of the relative intensity of different displays.

H. R. P.

EDWIN LANKESTER, M.D., F.R.S.

IT is with great regret that we have to announce the death, from diabetes, on Friday last (October 30), at Margate, of Dr. Lankester, the Coroner for Central Middlesex.

Dr. Lankester was born April 23, 1814, at Melton, near Woodbridge, in Suffolk, at which latter town he received his early education and commenced his medical studies. In 1834 he entered University College, London, as a